(c) calculating the minimum horizontal, vertical and diagonal pitches required between adjacent contacts within said array based upon a process of decomposing each of said contacts by sequentially exposing each edge of said image squares with radiation to produce the corresponding edge of said contacts on said substrate, said squares being offset relative to said substrate prior to each subsequent exposure in said sequence to align each of said image square edges to said corresponding edges of said contacts;

(d) identifying as belonging to a first set of contacts, which of said adjacent contacts in said array violates said pitches, said contacts which are not identified as belonging to said first set being included in a second set;

(e) forming a first decomposed image mask comprising the image squares corresponding to said second set of said contacts; and

(f) forming a second decomposed image mask comprising the image squares corresponding to said first set of said of contacts.

23. (Amended) The algorithm as defined in claim 22 wherein said minimum horizontal and vertical pitches [is defined as N, where N is] are equal to [CD] said minimum critical dimension, and said minimum diagonal pitch is defined as M, where M is given by the equation

$$M = \sqrt{2}\,(\lambda / NA).$$

REMARKS

Applicant respectfully requests reconsideration of this application as amended. By this amendment, the specification has been amended to correct minor informalities and the claims amended to more clearly distinguish the present invention from the prior art cited by the Examiner. Claim 13 has been canceled.

The Examiner has rejected claim 1 under 35 U.S.C. § 102(b) as being anticipated by Bohlen et al. Bohlen discloses a process in which two partial patterns are superimposed upon each other in a predetermined alignment to yield a desired feature pattern. The feature is equal to the sum of the partial pattern elements which overlap sectionally. According to Bohlen, the defined

overlapping of the partial patterns is achieved because the negative and positive windage shifts the contours of the individual pattern elements to the inside or outside, and because that part of the contours which appears only upon the cutting of a pattern elements participates only in the positive but not in the negative windage. Importantly, Bohlen is unconcerned with the printing of sub-resolution two-dimensional patterns in which the features to be printed have critical dimensions or patterned edges which are spaced narrower than the Rayleigh limit of the imaging tool.

The present invention greatly advances the photolithographic art by teaching a method of image decomposition which can be utilized with commercially-available imaging tools to radically improve the resolution limit of the lithographic process. Instead of developing new tools which have higher numerical apertures, or which utilize new exposure sources having shorter wavelengths, the present invention totally bypasses the Rayleigh limit constraint while producing the desired two dimensional feature patterns with much less complicated exposure routines as compared to the prior art. Thus, Applicant respectfully submits that the present invention is neither anticipated not rendered obvious by Bohlen.

Actually, Bohlen fails to even disclose features having first and second edges separated by a distance less than or equal to the Rayleigh limit of the imaging tool. To avoid errors in the alignment of one mask over the over, Bohlen teaches overlapping each of his partial patterns slightly to avoid disrupting conductor patterns. On the other hand, the present invention teaches decomposing feature edges by means of uncorrelated edge exposures in which the two feature edges are separated by less than the Rayleigh limit of the imaging tool. The problem that the present invention is aimed at is advancing the resolution limit of an imaging tool, beyond normal limits, whereas Bohlen is only concerned with the problem of patterning annular pattern elements to avoid problems of mechanical stability (see column 6, lines 43-64).

The Examiner also rejected claims 1-23 under 35 U.S.C.§103 as being unpatentable over Bohlen in view of Gilson. The Examiner considers that Gilson teaches employing shorter wavelength photons to improve the resolution limit of the imaging tool. Although such an approach is understandable, since the

resolution of the imaging tool is proportional to the wavelength, Applicant respectfully submits that Gilson's suggestion of shorter wavelength photons has nothing to do with the present invention. The present invention is aimed at relieving the Rayleigh limit, not with reducing the limit via shorter wavelength radiation. The invented method teaches decomposing the image wherein adjacent feature edges are printed in an uncorrelated fashion. Regardless of the wavelength of the imaging tool, the resolution of that imaging tool is limited by the wavelength of the energy source and the numerical aperture. Applicant readily acknowledges that higher resolution photolithographic processes can be produced by a new generation of imaging tools having either higher numeric apertures and/or shorter wavelength exposure sources. The present invention, however, obviates the need for advanced development of such improved imaging tools, and instead offers a novel method of image decomposition to relieve the Rayleigh limit--irrespective of the wavelength of the radiation source. Since neither Gilson nor Bohlen teach, disclose, or suggest the present invention of printing adjacent feature edges in an uncorrelated manner, Applicant respectfully submits that a skilled practitioner in the art would not have arrived at the present invention in consideration of Bohlen and Gilson.

Accordingly, Applicant respectfully submits that all rejections have now been overcome by this amendment and that all claims are now in condition for allowance. Such action is earnestly solicited.

Please charge any shortages or credit any overages to our Deposit Account No. 02-2666.

Respectfully submitted,

BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN

Date: 4/13, 1993

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